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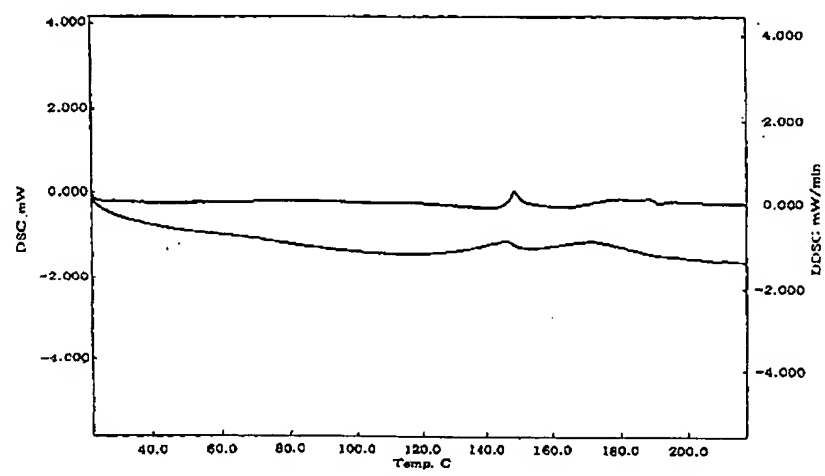
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(54) **NATEGLINIDE-CONTAINING PREPARATIONS**

(57) The present invention discloses, as a immediate-release preparation useful as an antidiabetic, a nateglinide-containing preparation comprising nateglinide as an active ingredient wherein the nateglinide is amorphous.

FIG. 1



EP 1 334 720 A1

**Description**

## Technical field of the Invention

5 **[0001]** The present invention relates to a preparation of nateglinide that is useful as an antidiabetic and more specifically to a immediate-release preparation of nateglinide.

## Background Art

10 **[0002]** It is known that nateglinide [compound name: N-(trans-4-isopropylcyclohexylcarbonyl)-D-phenylalanine] exhibits an excellent blood glucose-lowering effect by oral administration and therefore, is useful as a therapeutic agent for diabetes (Japanese Patent Publication No. Hei 4-15221).

**[0003]** On the other hand, the nateglinide is a poorly water soluble substance and therefore, capsules filled with nateglinide drug substance powder or ordinary tablets containing nateglinide do not dissolve well when administered orally because of its low disintegrating ability. As a result, such nateglinide-containing preparations can not show the fast-acting and short duration effect in decreasing a blood glucose level (fast-acting hypoglycemic agent), which is characteristic of nateglinide. In order to show the characteristic efficacy of nateglinide, the drug needs to be released rapidly from preparations and so improvement on a preparation has been required.

**[0004]** As methods for solving the problem, there has been provided a preparation wherein a low-substituted hydroxypropylcellulose is incorporated as a disintegrant (Japanese Patent No. 2508949).

**[0005]** Meanwhile, nateglinide has crystal polymorphs. Such a method wherein the disintegrant is incorporated into the preparation effectively enhance in disintegrating ability and increase in the dissolution rate of the preparation containing nateglinide in stable H-type crystal form and semi-stable crystal form. However, it can not be regarded as effective in all crystal forms of nateglinide.

25 **[0006]** Besides, when the nateglinide in crystal forms other than the most stable H-type crystal forms and the semi-stable crystal forms are used, it is known that crystal transition happens during producing or conserving preparations. It is generally preferred that crystal transition of drugs does not happen during producing or conserving pharmaceutical preparations.

## 30 Disclosure of the Invention

**[0007]** An object of the present invention is to provide, as a nateglinide-containing preparation, a pharmaceutical preparation containing amorphous nateglinide wherein dissolution rate of drugs is high and crystal transition does not happen during producing or conserving preparations.

35 **[0008]** For the purpose of solving the problems, the inventors have vigorously studied and found that dissolution property can be improved by making nateglinide amorphous in a preparation and the like. The present invention has been completed on the basis of this finding. According to the method of the present invention, it is possible to provide, from nateglinide in any crystal polymorphs, an immediate-release preparation of nateglinide wherein dissolution rate of drugs is high and crystal transition does not happen during producing or conserving preparations. The present invention basically relates to a nateglinide-containing preparation as an active ingredient, wherein the nateglinide is amorphous. The present invention includes the following each invention:

- (1) A nateglinide-containing preparation comprising nateglinide as an active ingredient wherein the nateglinide is amorphous.
- 45 (2) The nateglinide-containing preparation according to (1), wherein the amorphous nateglinide is produced by a solvent removal process from a solution of nateglinide in a solvent.
- (3) The nateglinide-containing preparation according to (2), wherein the solvent used in the solvent removal process is a mixture of ethanol and water.
- (4) The nateglinide-containing preparation according to (1), wherein the amorphous nateglinide is produced by applying a high shear stress.
- 50 (5) The nateglinide-containing preparation according to (1), wherein the amorphous nateglinide is produced by melt granulation process.
- (6) The nateglinide-containing preparation according to (2), which comprises hydrophilic materials as carriers.
- (7) The nateglinide-containing preparation according to (6), wherein the hydrophilic materials are selected from the group consisting of water-soluble polymers, water-swelling polymers, sugar alcohols and salts.
- 55 (8) The nateglinide-containing preparation according to (7), wherein the water-soluble polymers or the water-swelling polymers are selected from the group consisting of polyvinyl pyrrolidone derivatives, polysaccharide derivatives, polyacrylic acid derivatives, polylactic acid derivatives, polyoxyethylene derivatives, polyvinyl alcohol derivatives

and surfactants.

(9) The nateglinide-containing preparation according to (8), wherein the polysaccharide derivatives are selected from the group consisting of methylcellulose SM-4, hydroxypropylcellulose SL and hydroxypropylcellulose SSL.

(10) The nateglinide-containing preparation according to (8), wherein the polyoxyethylene derivatives are polyethyleneglycol.

(11) The nateglinide-containing preparation according to (7), wherein the sugar alcohols is selected from the group consisting of sorbitol, xylitol and mannitol.

(12) The nateglinide-containing preparation according to (7), wherein the water-swelling polymers are crospovidone (COLIDONE CL-M).

(13) The nateglinide-containing preparation according to (1), wherein the preparation is a tablet containing the amorphous nateglinide.

(14) The nateglinide-containing preparation according to (1), wherein the product is a capsule filled with liquid in which nateglinide is dissolved.

(15) The nateglinide-containing preparation according to (14), wherein the liquid in which nateglinide is dissolved is either water-soluble polymers or surfactants.

(16) The nateglinide-containing preparation according to (15), wherein the water-soluble polymers or the surfactants dissolving nateglinide are polyoxyethylene derivatives.

(17) A method for producing an amorphous nateglinide-containing preparation, which comprises the steps of dissolving nateglinide crystals into a pharmacologically acceptable solvent together with hydrophilic materials selected from the group consisting of water-soluble polymers, water-swelling polymers, sugar alcohols and salts, and subjecting the resulting solution to a process selected from the group consisting of a fluidized bed granulation process, a high-speed mixing granulation process, a spray-dry process and a coating process to granulate the amorphous nateglinide.

(18) A method for producing an amorphous nateglinide-containing preparation, which comprises the steps of mixing nateglinide crystals with hydrophilic materials selected from the group consisting of water-soluble polymers, water-swelling polymers, sugar alcohols and salts, and then applying a shear stress to the resulting mixture.

(19) A method for producing an amorphous nateglinide-containing preparation, which comprises the steps of mixing nateglinide crystals with hydrophilic materials selected from the group consisting of water-soluble polymers, water-swelling polymers, sugar alcohols and salts, and then subjecting the resulting mixture to a melt-kneading with heating and grinding with cooling.

(20) A method for producing an amorphous nateglinide-containing preparation, which comprises the step of dissolving nateglinide crystals into pharmacologically acceptable liquid additives.

#### Brief Description of the Drawings

#### [0009]

Figure 1 shows a DSC pattern of amorphous nateglinide tablets.

Figure 2 shows a DSC pattern of B-type crystal form of a nateglinide drug substance.

Figure 3 shows a DSC pattern of H-type crystal form of a nateglinide drug substance.

Figure 4 shows a DSC pattern of amorphous nateglinide tablets after one week conservation packed in an aluminum bag at 50°C.

Figure 5 shows a DSC pattern of amorphous nateglinide tablets after one month conservation packed in an aluminum bag at 40°C, 75%RH.

Figure 6 shows a comparative diagram of dissolution profiles of each preparation of Examples 2 and 3 and Comparative Examples 1 to 3.

Figure 7 shows a change in a nateglinide concentration in blood plasma when nateglinide tablets were administered to beagles five minutes before meal. Average  $\pm$  SE, n=3.

Figure 8 shows a change in blood glucose level when nateglinide tablets were administered to beagles five minutes before meal. Average  $\pm$  SE, n=3.

Figure 9 shows a DSC pattern of amorphous nateglinide tablets after six month conservation packed in an aluminum bag at 40°C, 75%RH.

#### Best Mode for Carrying out the Invention

**[0010]** Nateglinide, which is a raw material of amorphous nateglinide that is contained in the pharmaceutical preparation of the present invention may be synthesized by the method described in, for example, Japanese Patent Publication No. Hei 4-15221, and the crystal forms thereof are not particularly limited.

**[0011]** Preparation methods for amorphous nateglinide include, for example, a solvent removal process, a process applying a high shear stress, a melt granulation process, and a process dissolving into a pharmaceutically acceptable solvent. Other methods are also acceptable if only it can make nateglinide amorphous. Among these methods, the solvent removal process and the process dissolving into a pharmaceutically acceptable solvent are preferable in view of easy-productibility and the like. Making amorphous state can be accomplished without a carrier.

**[0012]** A hydrophilic material is preferable as a carrier that makes nateglinide amorphous. Examples thereof include water-soluble polymers, water-swelling polymers, sugar alcohols and salts. Carriers may be any of those which can make nateglinide amorphous and dissolve or swell rapidly in water. The addition amount is preferably 0.1 or more by weight to drugs. It is more preferably 0.1 to 100 by weight and further more preferably 0.1 to 50 by weight to nateglinide.

**[0013]** A solvent for dissolving nateglinide is preferably a pharmaceutically acceptable liquid at about 37°C. Examples thereof are water-soluble polymers and surfactants. The solvent is added preferably 0.1 or more by weight to drugs. It is more preferably 0.1 to 1000 by weight to nateglinide and further more preferably 0.1 to 100 by weight to nateglinide. It is preferably 0 to 100 by weight and more preferably 0 to 50 by weight to a carrier that makes nateglinide amorphous.

**[0014]** The solvent removal process for obtaining amorphous nateglinide used in the pharmaceutical preparations of the present invention is a method wherein drugs and a carrier for making amorphous state are dissolved into a solvent, and then the solvent is removed to make the drugs amorphous. The solvent may be any of an aqueous type, an organic type and a mixed type of water and an organic solvent, as long as drugs and the carrier can be dissolved therein. Concretely, it includes alcohols such as methanol, ethanol and isopropyl alcohol, ketones such as acetone and methylethyl ketone, cyclic ethers such as dioxane and tetrahydrofuran, and acetonitrile. Ethanol is preferred among them. When the mixed type of water and an organic solvent is used, their ratio (mass ratio) is preferably water: an organic solvent = 99:1 to 1:99 and more preferably 90:10 to 10:90.

**[0015]** An example of the solvent removal process includes a method wherein drugs and a carrier that make nateglinide amorphous such as water-soluble polymers are dissolved into a solvent such as ethanol, and then the solution is subjected to drying under vacuum, evaporation and the like to remove the solvent. Conditions of removal of the solvent are not particularly limited as long as amorphous nateglinide can exist stably. The operation can be conducted by using nateglinide and the solvent without a carrier for making amorphous state. The amorphous nateglinide may be subjected to a fluidized-bed granulation process, a high-speed mixing granulation process, a spray-dry process, a coating process and the like to obtain granules containing amorphous nateglinide. Without removing the solvents from the solution into which nateglinide and the carrier that makes nateglinide amorphous are dissolved, the solution may be directly subjected to the fluidized-bed granulation process, the high-speed mixing granulation process, the spray-dry process, the coating process and the like to directly obtain a granulated nateglinide-containing preparation. Conditions of the fluidized-bed granulation and the like are not particularly limited as long as amorphous nateglinide can exist stably. The operation can be conducted by nateglinide alone. The obtained granules can be utilized as dosage form, granules, or further be compressed to tablets. Dosage forms of the nateglinide-containing preparation of the present invention are not particularly limited.

**[0016]** The method for producing preparations by applying a high shear stress is the method wherein a high shear stress is applied to the mixture of drugs and a carrier for making amorphous state by an appropriate method to make the drugs amorphous. The applied shear stress is not particularly limited as long as amorphous nateglinide can exist stably. The operation can be conducted by nateglinide alone.

**[0017]** For example, there is a method wherein drugs and water-soluble polymers are mixed, and then the mixture is coground with an ultracentrifugal mill, or a high shear stress is applied to the mixture by an extrusion granulator, to obtain granules containing the amorphous drugs. The obtained granules can be utilized as dosage form, granules, or further be compressed to tablets. Dosage forms of the nateglinide-containing preparation of the present invention are not particularly limited.

**[0018]** The melt granulation process is the method wherein the mixture of drugs and a carrier for making amorphous state is heated and melted and then it is cooled and solidified to make the drugs amorphous.

**[0019]** For example, drugs and water-soluble polymers are placed in a heat-resistant multi-purpose mixer or the like, melt-kneaded with heating, and ground with cooling to obtain granules containing the amorphous drugs. The obtained granules can be utilized as dosage form, granules, or, insofar as an amorphous state is maintained, dosage forms of the nateglinide-containing preparation of the present invention are not particularly limited. The operation can be conducted by nateglinide alone.

**[0020]** The method dissolving into a pharmaceutically acceptable liquid additives is the method wherein drugs are dissolved into a pharmaceutically acceptable liquid additive to make the drugs amorphous.

**[0021]** For example, there may be a method wherein drugs are dissolved into water-soluble polymers that is liquid at 37°C to obtain a solution. The solution is filled in a hard capsule shell, or it is filled in a soft capsule shell to be a liquid-filled capsule.

**[0022]** The preparation containing amorphous nateglinide of the present invention can further comprise hydrophilic materials. The hydrophilic materials include water-soluble polymers, water-swelling polymers, sugar alcohols, salts

and the like. As such hydrophilic materials, the same one can be used as the carrier that makes nateglinide amorphous or a different materials can also be used.

**[0023]** Examples of water-soluble polymers or water-swelling polymers are polyvinyl pyrrolidone derivatives, polysaccharide derivatives, polyacrylic acids derivatives, polylactic acids derivatives, polyoxyethylene derivatives, polyvinyl alcohol derivatives and surfactants.

**[0024]** The polyvinyl pyrrolidone derivatives include cross-linked polyvinyl pyrrolidone and more concretely crospovidone (COLIDONE CL-M, BASF).

**[0025]** The polysaccharide derivatives as the hydrophilic materials include cellulose derivatives and the like. Examples thereof are methylcellulose, hydroxypropylcellulose and carboxymethylcellulose. More concretely, it includes methylcellulose SM-4, hydroxypropylcellulose SL and hydroxypropylcellulose SSL.

**[0026]** The polyacrylic acids derivatives include methacrylic acid copolymer L, methacrylic acid copolymer S and methacrylic acid copolymer LD (Rohm)

**[0027]** The polylactic acids derivatives include copolymer of lactic acid and glycolic acid (1:1) having a molecular weight of 17000 to 24000.

**[0028]** As an example of the polyoxyethylene derivatives, polyethylene glycol is preferred. Particularly, its molecular weight is preferably 200 to 20000 and more preferably 200 to 6000. Concretely, it includes macrogol 300, 400, 600, 1000, 1500, 4000, 6000 or the like.

**[0029]** The polyvinyl alcohol derivatives include polyvinyl alcohols (completely saponified matters), polyvinyl alcohols (partially saponified matters) and the like.

**[0030]** The surfactants include polysorbate 80, sodium lauryl sulfate and the like.

**[0031]** As the water-swelling polymers, crospovidone (COLIDONE CL-M) is preferred.

**[0032]** Sugar alcohols include sorbitol, xylitol, mannitol and the like. Mannitol is preferred among them.

**[0033]** The salts include sodium chloride, phosphates, citrates and the like.

#### Examples

**[0034]** The following Examples will further illustrate the present invention, which by no means limit the invention.

#### Example 1: Production of amorphous nateglinide

**[0035]** 4 g of nateglinide in B-type crystal form and 32 g of polyvinyl pyrrolidone were dissolved into ethanol. Ethanol was removed by evaporation (60°C), and the mixture was dried under vacuum at 60°C for 3 hours or more. The solid material was ground in a mortar to obtain 36 g of nateglinide in the form of solid dispersion.

#### Examples 2: Production of tablets containing amorphous nateglinide

**[0036]** 60 g of nateglinide (B-type crystals), 4 g of hydroxypropylcellulose and 60 g of crospovidone (COLIDONE CL-M, BASF) were dissolved and suspended into 160 g of ethanol to obtain a binder solution. 180 g of crospovidone (COLIDONE CL-M, BASF) and 96 g of crystalline cellulose were placed in a fluidized bed granulator (FLO-1 type, Freund Industrial Co., Ltd.) and mixed together. Then the binder solution was sprayed to granulate into a fluidized bed (intake temperature: 80°C, spray speed: 4.9 g/min., spray pressure: 1.8 kgf/cm<sup>2</sup>).

**[0037]** 250 g of the obtained granules and 3.8 g of magnesium stearate were mixed in a V-type mixer to obtain granules for tableting. A rotary tableting machine (HT-AP15-ssII, Hata Factory) was used with a punch of 8mm  $\phi$  -14R2r to obtain 253.8 g of core tablets (weight of the core tablet: 203.1 mg).

**[0038]** 80 g of hydroxypropylmethylcellulose, 15 g of macrogol 6000, 24 g of talc and 5 g of titanium oxide were dissolved and suspended into 876 g of water to prepare a liquid for coating. 300 g of the core tablets were placed in a tablet coater ("High Coater Mini", Freund Industrial Co., Ltd.). The tablets were coated so that 2.54 mg of hydroxypropylmethylcellulose is coated on one core tablet, to obtain 303.8 g of coated tablets.

**[0039]** The produced tablets was packed in an aluminum bag and stability test was conducted at 50°C for one week or at 40°C, 75%RH, for one month.

#### Example 3: Production of liquid-filled capsules

**[0040]** 186 mg of nateglinide, 1456 mg of macrogol 400 and 1456 mg of polysorbate 80 were mixed in a stirrer at room temperature until they were dissolved and a transparent solution of nateglinide was prepared. 500 mg of the drug solution was filled in size 0 capsules to obtain liquid-filled capsules (nateglinide: 30 mg).

Comparative Example 1: Production of a capsule 1 filled with drug substance powder

[0041] 300 mg of nateglinide drug substance powder (B-type crystals) was filled in a gelatin capsule (size 2) to obtain a capsule filled with nateglinide drug substance powder in B-type form.

Comparative Example 2: Production of a capsule 2 filled with drug substance powder

[0042] 30 mg of nateglinide drug substance powder (H-type crystals) was filled in a gelatin capsule (size 2) to obtain a capsule filled with nateglinide drug substance powder in H-type form.

Comparative Example 3: Production of tablets by using nateglinide in H-type crystals

[0043] A core tablet (weight: 120 mg) of 7mm  $\phi$ -9R2r was obtained by using nateglinide (H-type crystals) according to Example 1 of Japanese Patent Publication No. Hei 10-194969. Then it was coated to obtain a coated tablet containing nateglinide in H-type crystals.

Example 4: Measurement of DSC

[0044] The tablets produced in Example 2 were ground in an agate mortar and about 10 mg of the powder was placed in a silver pan and encapsulated by a silver lid. Then, DSC was measured by SII-DSC instrument under the condition wherein temperature was increased from 25°C to 250°C at a heating rate: 5°C/min. The results are shown in Figure 1. They were compared with those of nateglinide drug substance powder in B-type form (Figure 2) and those of nateglinide drug substance in H-type form (Figure 3). As is apparent from Figure 1 to Figure 3, the tablets produced in Example 2 were confirmed to contain amorphous Nateglinide because they did not show absorption, which is characteristic of nateglinide crystals.

[0045] Meanwhile, a conservation tested sample of the preparations of Example 2 was measured by the same procedure mentioned above. The obtained DSC charts (Figure 4 and Figure 5) were the same as those obtained before a conservation test. Therefore, it was confirmed that nateglinide did not crystallize and was amorphous (no transition of crystal forms).

Example 5: Measurement of dissolution rate

[0046] Dissolution property of the preparations produced in Example 2 and Example 3 was measured in 900mL of the second fluid in Japanese Pharmacopoeia disintegration test in accordance with Japanese Pharmacopoeia (hereinafter referred to as JP), Chapter 13, a puddle method (50 rpm). The results are shown in Figure 6. The preparations produced in Comparative Example 1 to Comparative Example 3 were measured by the same method mentioned above. The results are shown in Figure 6.

[0047] As is apparent from Figure 6, dissolution rates of the tablets produced in Example 2 and liquid-filled capsules produced in Example 3, wherein nateglinide were amorphous, are improved as compared with those of the capsules filled with drug substance powder produced in Comparative Example 1 and Comparative Example 2. The average dissolution rate of the tablets containing amorphous Nateglinide and liquid-filled capsules at each time point was confirmed as showing the same dissolution property as those of nateglinide tablets (tablets using H-type crystals) of Comparative Example 3.

[0048] Meanwhile, dissolution property of the preparations produced in Example 2 and of those after the conservation test were measured in 500mL of the second fluid in Japanese Pharmacopoeia disintegration test in accordance with JP, Chapter 13, a puddle method (50 rpm, 30 minutes later). The results are shown in Table 1. As is apparent from Table 1, any change in the dissolution rate was not observed either before or after the conservation test.

Table 1

Test samples	Before conservation	50°C, one week later	40°C, RH 75%, one month later
Dissolution rate (%)	93	95	91

Example 6: Evaluation of oral absorbability on beagles

[0049] A profile of a nateglinide concentration in blood plasma, a change in blood glucose level and a pharmacokinetic parameter were evaluated when amorphous nateglinide tablets obtained in Example 2 and nateglinide in H-type crystal form tablets obtained in Comparative Example 3 were administered to beagles five minutes before meal. The results

are shown in Figure 7, Figure 8 and Table 2.

**[0050]** It was clarified that amorphous nateglinide tablets have equivalent or better oral absorbability and efficacy than those of nateglinide in H-type crystal form tablets.

Table 2:

Pharmacokinetic parameter when nateglinide tablets were administered to beagles five minutes before meal (n=3)			
	AUC[ $\mu\text{g/mL} \cdot \text{hr}$ ]	Cmax[ $\mu\text{g/mL}$ ]	Tmax[hr]
Nateglinide in H-type crystal form tablets	20.53	8.93	0.38
Amorphized nateglinide tablets	22.29	9.46	0.38

Example 7: Evaluation of conservation stability of amorphous nateglinide tablets

**[0051]** The amorphous nateglinide tablets obtained in Example 2 were packed in an aluminum bag and conserved at 40°C, 75%RH for six months. Dissolution property was evaluated in 500mL of the second fluid in JP disintegration test in accordance with JP, Chapter 13, a puddle method (50 rpm, 30 minutes later). The results are shown in Table 3 and a DSC chart is shown in Figure 9.

**[0052]** Any changes in dissolution rate and a DSC pattern were not observed either before or after the conservation. It indicates that amorphous nateglinide tablets are the preparation having high conservation stability.

Table 3:

Comparison of solubility before and after the conservation		
Tablets	Dissolution Rate	
	Initial stage	40°C, 75%, 6M
Amorphous nateglinide tablets	93(93-94)	101(99-104)

**[0053]** It is apparent from each figure and Table 1 that amorphous nateglinide used in the preparation of the present invention does not transit to crystal forms during producing or conserving it. According to the present invention regarding the preparation using the amorphous nateglinide, while it contains nateglinide useful as an antidiabetic in the non-crystalline form, it is possible to produce preparations having high dissolution property equivalent to those containing crystalline nateglinide.

## Claims

1. A nateglinide-containing preparation comprising nateglinide as an active ingredient wherein the nateglinide is amorphous.
2. The nateglinide-containing preparation according to claim 1, wherein the amorphous nateglinide is produced by a solvent removal process from a solution of nateglinide in a solvent.
3. The nateglinide-containing preparation according to claim 2, wherein the solvent used in the solvent removal process is a mixture of ethanol and water.
4. The nateglinide-containing preparation according to claim 1, wherein the amorphous nateglinide is produced by applying a high shear stress.
5. The nateglinide-containing preparation according to claim 1, wherein the amorphous nateglinide is produced by melt granulation process.
6. The nateglinide-containing preparation according to claim 2, which comprises hydrophilic materials as carriers.
7. The nateglinide-containing preparation according to claim 6, wherein the hydrophilic materials are selected from the group consisting of water-soluble polymers, water-swelling polymers, sugar alcohols and salts.

8. The nateglinide-containing preparation according to claim 7, wherein the water-soluble polymers or the water-swelling polymers are selected from the group consisting of polyvinyl pyrrolidone derivatives, polysaccharide derivatives, polyacrylic acids derivatives, polylactic acids derivatives, polyoxyethylene derivatives, polyvinyl alcohol derivatives and surfactants.
9. The nateglinide-containing preparation according to claim 8, wherein the polysaccharide derivatives are selected from the group consisting of methylcellulose SM-4, hydroxypropylcellulose SL and hydroxypropylcellulose SSL.
10. The nateglinide-containing preparation according to claim 8, wherein the polyoxyethylene derivatives are polyethyleneglycol.
11. The nateglinide-containing preparation according to claim 7, wherein the sugar alcohols is selected from the group consisting of sorbitol, xylitol and mannitol.
12. The nateglinide-containing preparation according to claim 7, wherein the water-swelling polymers are crospovidone (COLIDONE CL-M).
13. The nateglinide-containing preparation according to claim 1, wherein the preparation is a tablet containing the amorphous nateglinide.
14. The nateglinide-containing preparation according to claim 1, wherein the product is a capsule filled with liquid in which nateglinide is dissolved.
15. The nateglinide-containing preparation according to claim 14, wherein the liquid in which nateglinide is dissolved is either water-soluble polymers or surfactants.
16. The nateglinide-containing preparation according to claim 15, wherein the water-soluble polymers or the surfactants dissolving nateglinide are polyoxyethylene derivatives.
17. A method for producing an amorphous nateglinide-containing preparation, which comprises the steps of dissolving nateglinide crystals into a pharmacologically acceptable solvent together with hydrophilic materials selected from the group consisting of water-soluble polymers, water-swelling polymers, sugar alcohols and salts, and subjecting the resulting solution to a process selected from the group consisting of a fluidized bed granulation process, a high-speed mixing granulation process, a spray-dry process and a coating process to granulate the amorphous nateglinide.
18. A method for producing an amorphous nateglinide-containing preparation, which comprises the steps of mixing nateglinide crystals with hydrophilic materials selected from the group consisting of water-soluble polymers, water-swelling polymers, sugar alcohols and salts, and then applying a shear stress to the resulting mixture.
19. A method for producing an amorphous nateglinide-containing preparation, which comprises the steps of mixing nateglinide crystals with hydrophilic materials selected from the group consisting of water-soluble polymers, water-swelling polymers, sugar alcohols and salts, and then subjecting the resulting the mixture to a melt-kneading with heating and grinding with cooling.
20. A method for producing an amorphous nateglinide-containing preparation, which comprises the step of dissolving nateglinide crystals into pharmacologically acceptable liquid additives.



FIG. 1

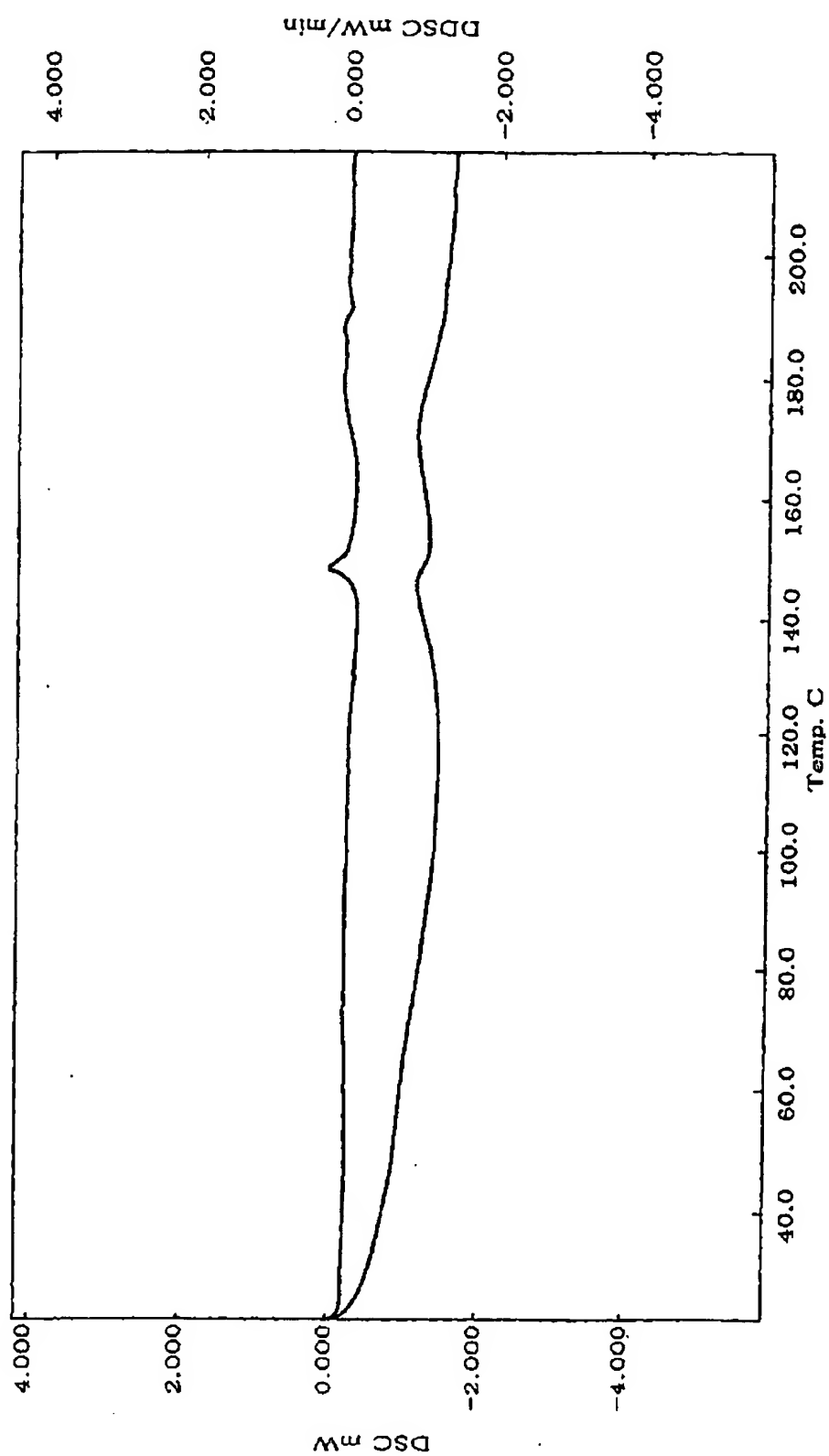


FIG. 2

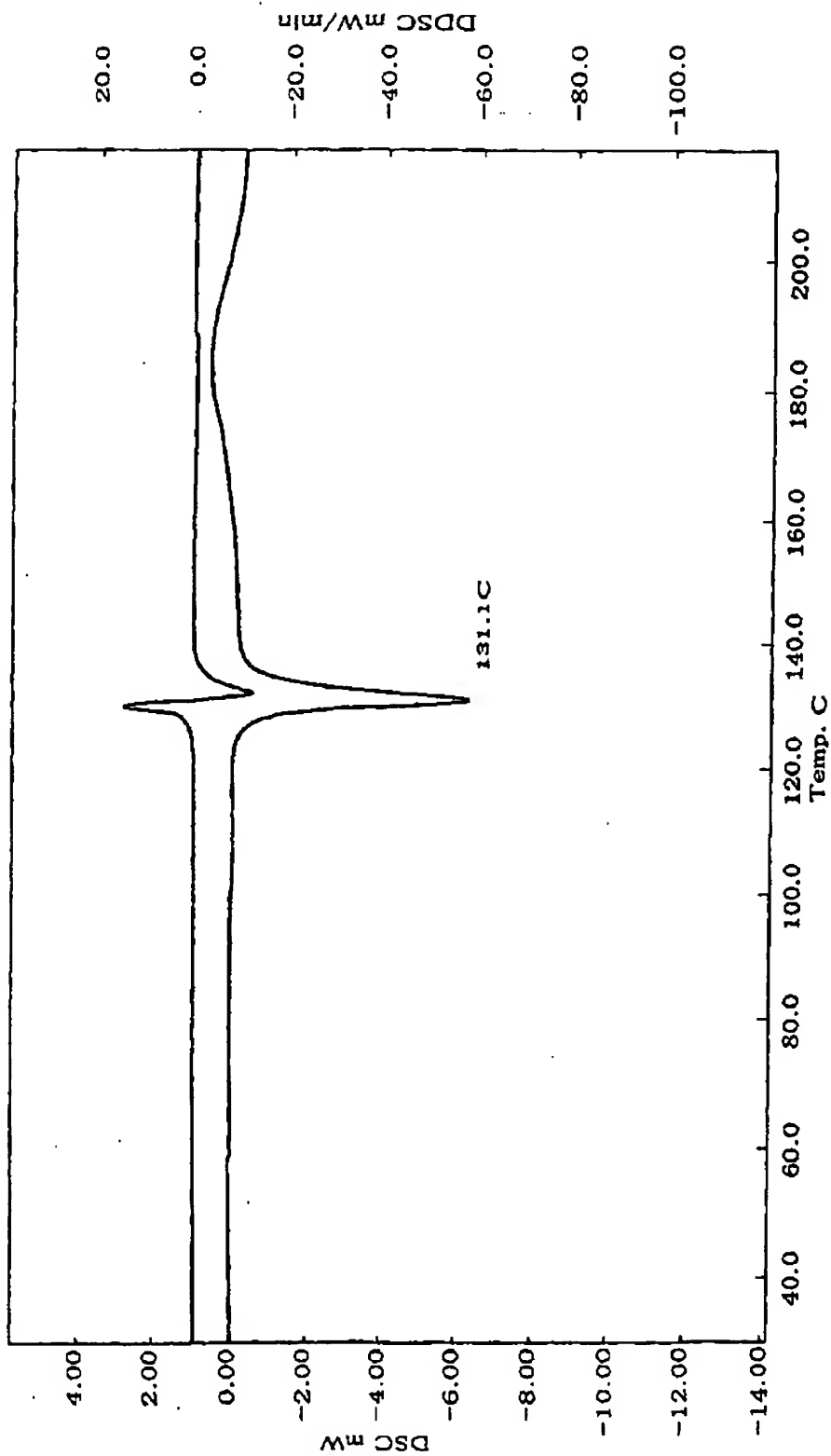


FIG. 3

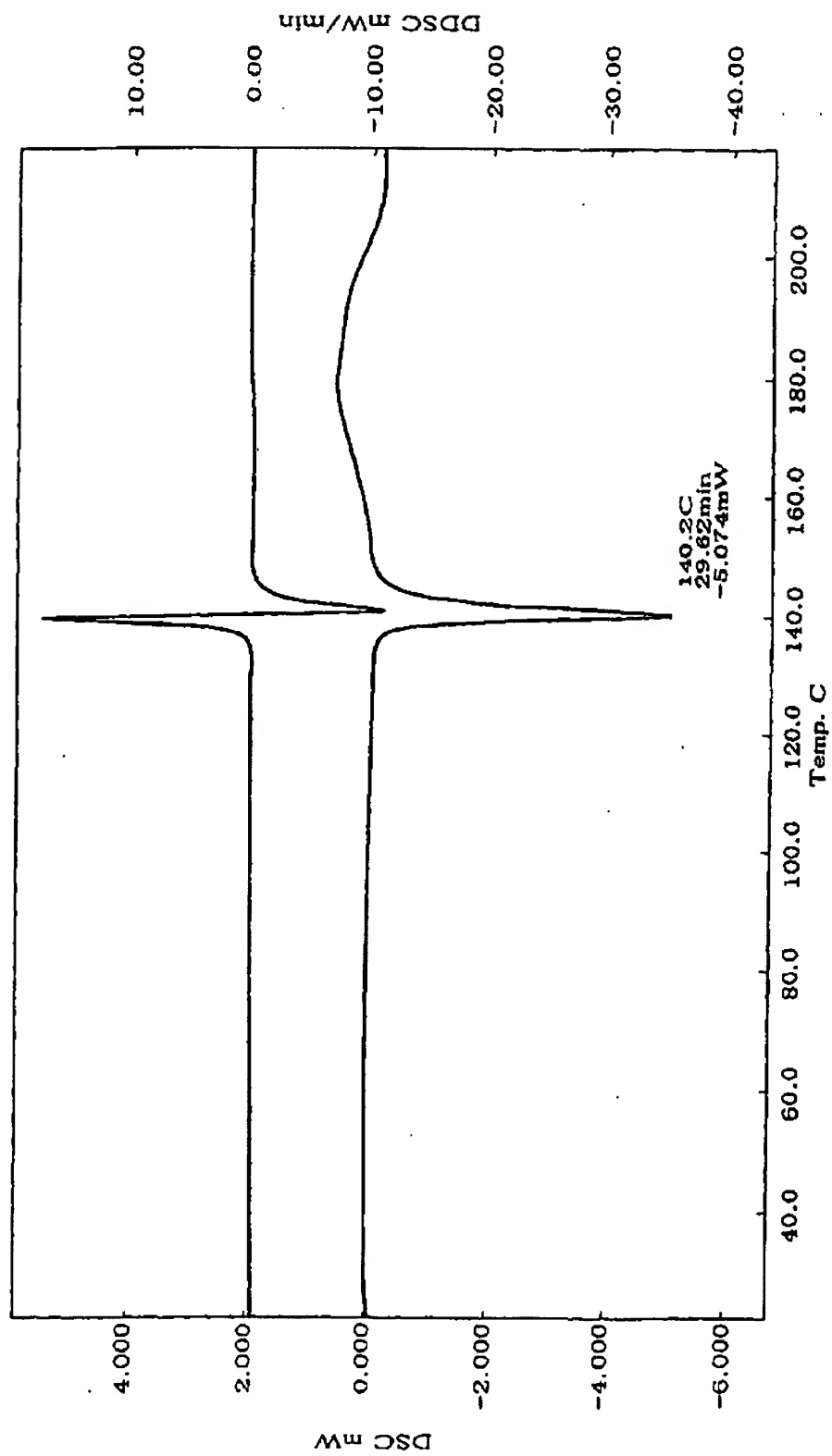


FIG. 4

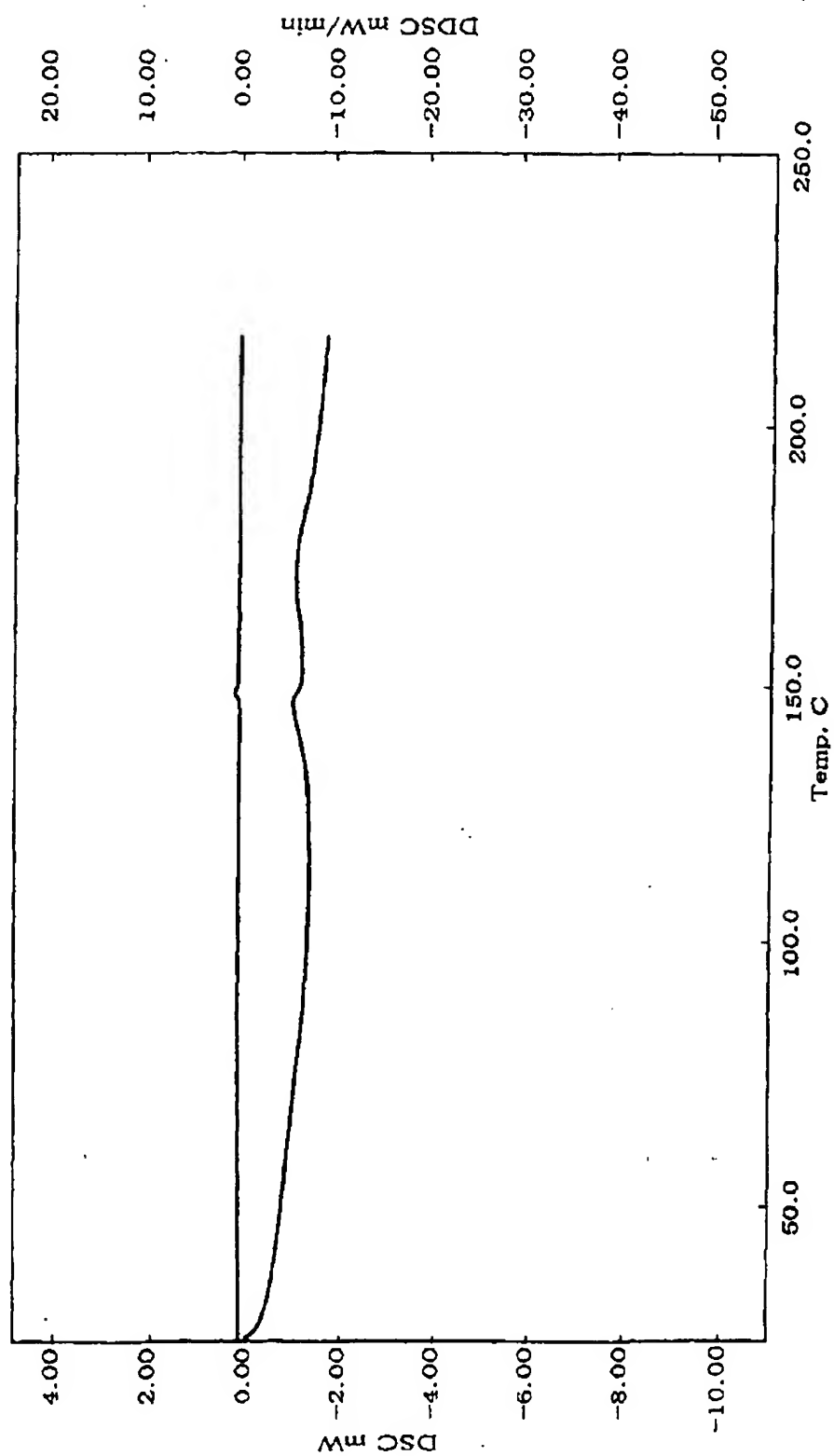


FIG. 5

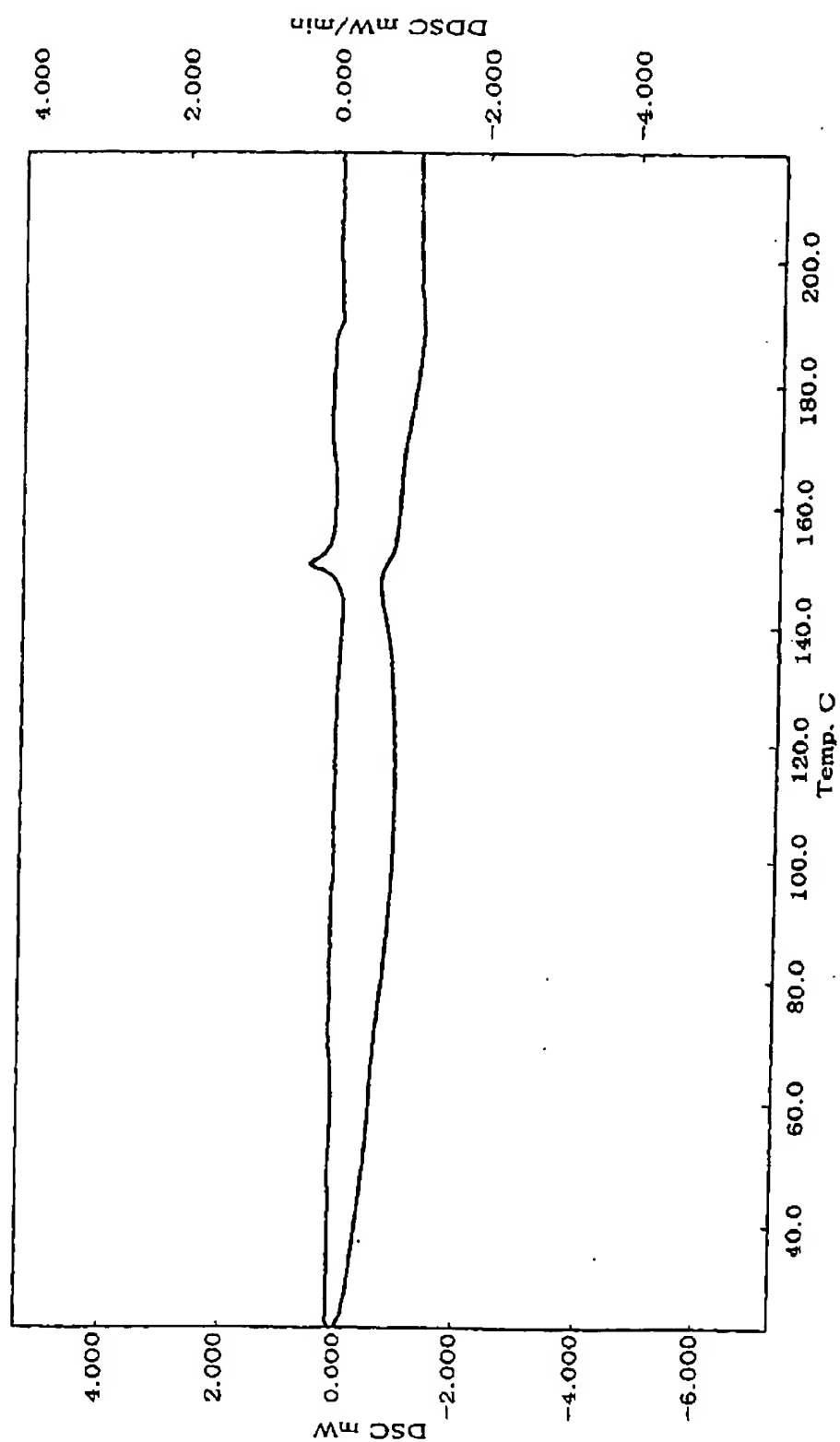


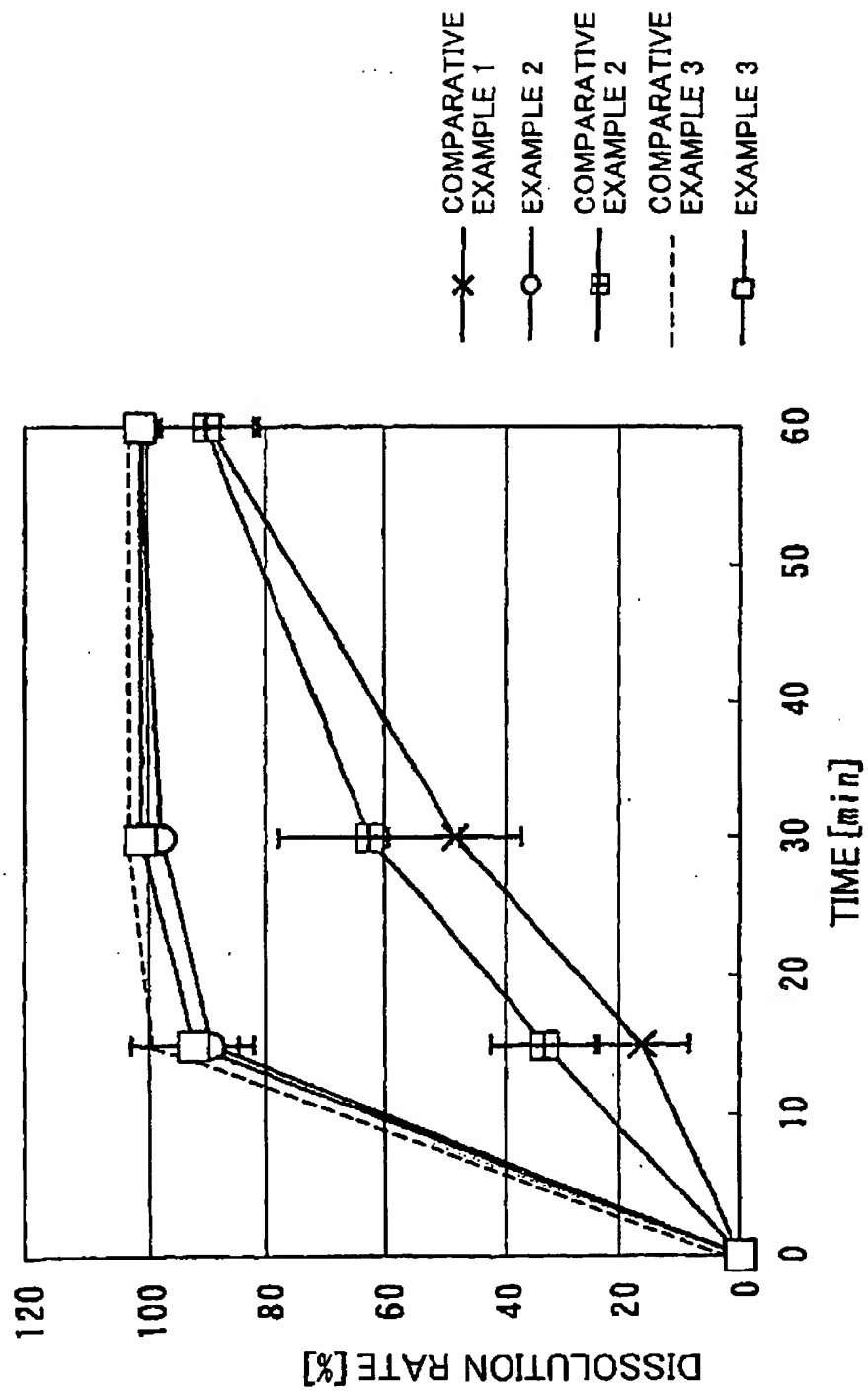
FIG. 6  
JP2 FLUID DISSOLUTION RATE

FIG. 7

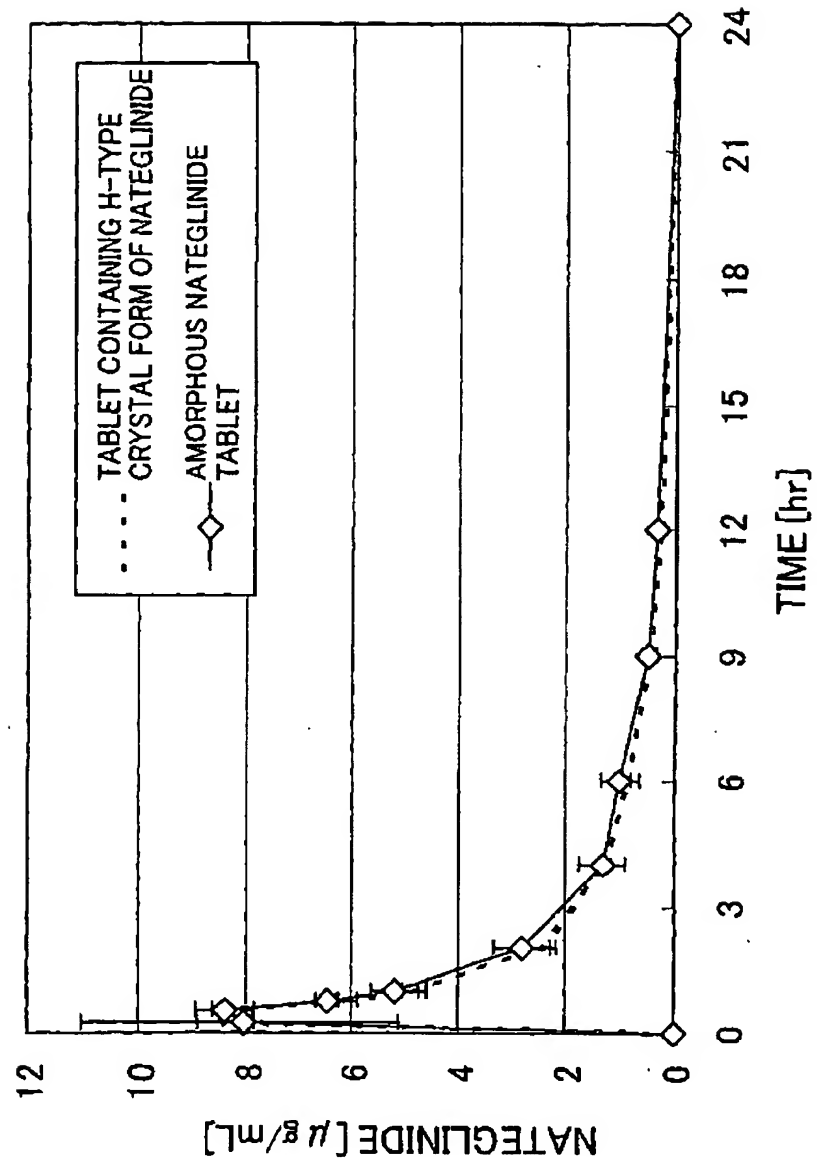


FIG. 8

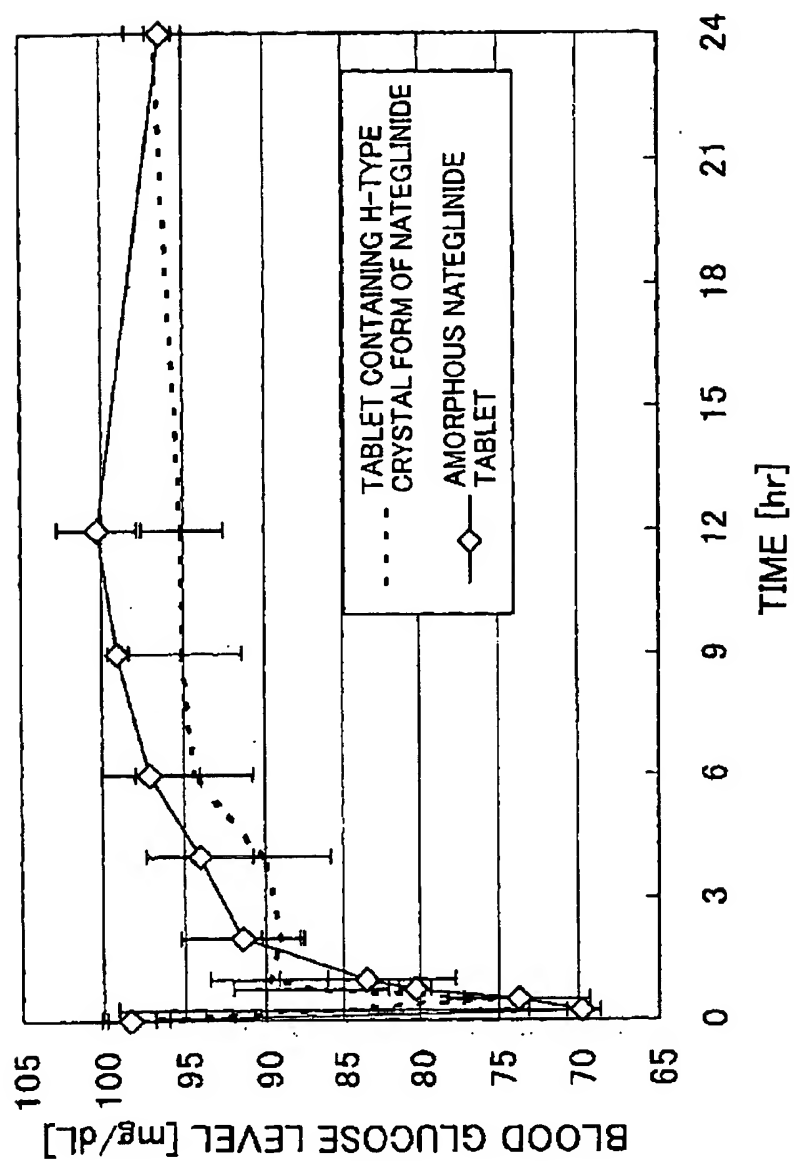
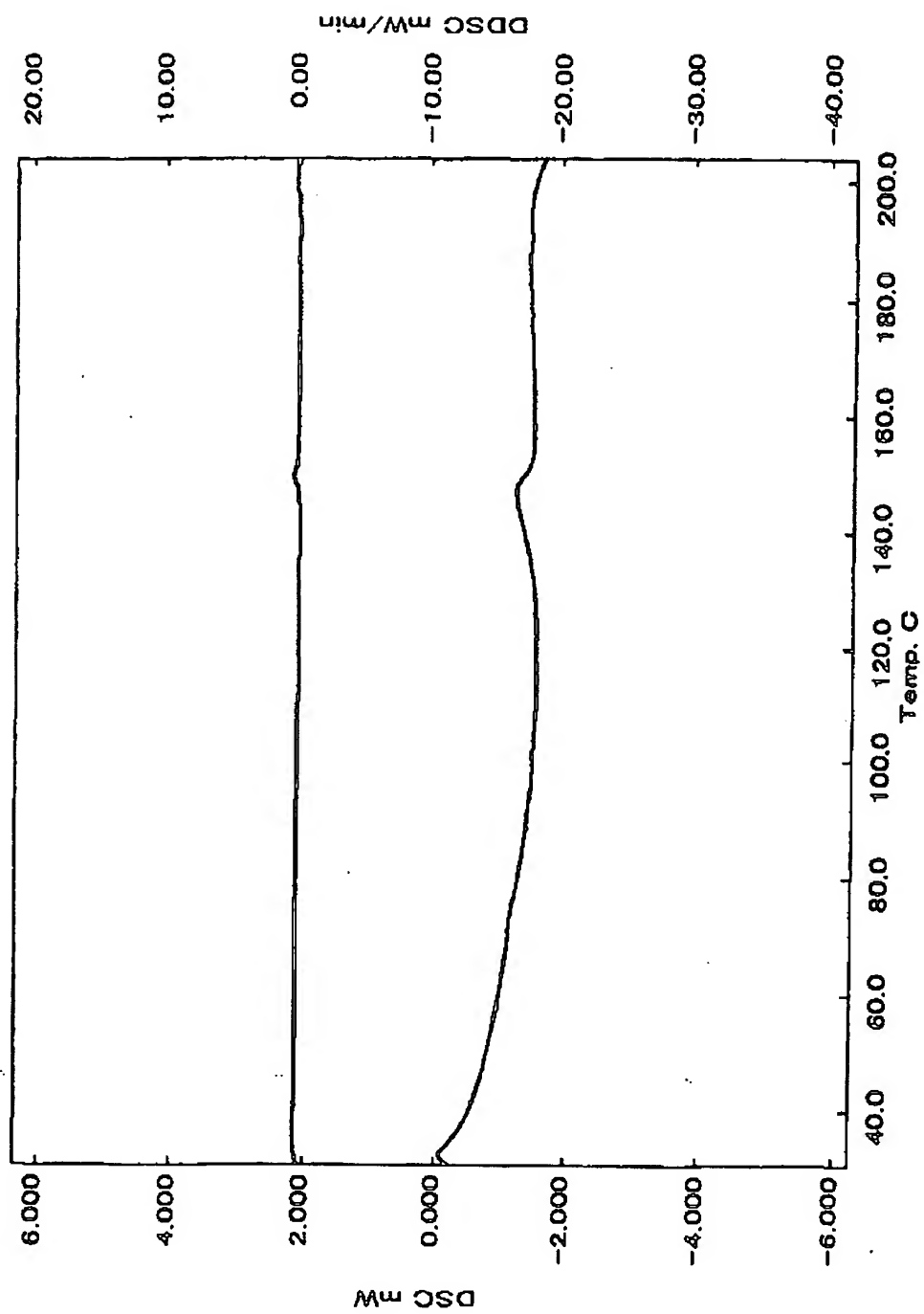




FIG. 9



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/09291

## A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl.<sup>7</sup> A61K31/198, 9/06, 9/16, 9/20, 9/48, 47/10, 47/32, 47/34, 47/38 //  
A61P3/10

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl.<sup>7</sup> A61K31/198, 9/06, 9/16, 9/20, 9/48, 47/10, 47/32, 47/34, 47/38 //  
A61P3/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CAPLUS (STN), MEDLINE (STN), EMBASE (STN)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 965339 A1 (AJINOMOTO CO. INC.), 22 December, 1999 (22.12.1999) & US 9143323 A & WO 98/22105 A1 & JP 10-194969 A	1-20
A	EP 526171 A2 (AJINOMOTO CO. INC.), 03 February, 1993 (03.02.1993) & US 5463116 A & US 5488150 A & JP 5-208943 A	1-20

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&amp;" document member of the same patent family

Date of the actual completion of the international search  
07 January, 2002 (07.01.02)Date of mailing of the international search report  
15 January, 2002 (15.01.02)Name and mailing address of the ISA/  
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.